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(54) Title: LARGE DIAMETER OPTICAL WAVEGUIDE, GRATING, AND LASER

(57) Abstract: A large diameter optical waveguide, grating, and laser includes a waveguide (10) having at least one core surrounded by a cladding, the core propagating light in substantially a few transverse spatial modes; and having an outer waveguide dimension of said waveguide being greater than about 0.3mm. The waveguide may be axially compressed which causes the length of the waveguide to decrease without buckling. The waveguide may be used for any application where a waveguide needs to be compression tuned, e.g., compression-tuned fiber Bragg gratings and lasers or other applications. Also, the waveguide exhibits lower mode coupling from the core to the cladding and allows for higher optical power to be used when writing gratings without damaging the waveguide. The shape of the waveguide may have other geometries (e.g., a "dogbone" shape) and/or more than one grating or pair of gratings may be used and more than one core may be used. The core and/or cladding may be doped with a rare-earth dopant and/or may be photosensitive. At least a portion of the core may be doped between a pair of gratings to form a fiber laser. Also a tunable DFB fiber laser or an interactive fiber laser can be constructed within the waveguide. The waveguide may resemble a short "block" or a longer "cane" type, depending on the application and dimensions used.

# INTERNATIONAL SEARCH REPORT

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**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 G02B6/12 G02B6/16 H01S3/067

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 G02B H01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, PAJ, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 884 614 A (SUMITOMO ELECTRIC INDUSTRIES) 16 December 1998 (1998-12-16)	1,6,15, 16,18, 20-26
Y	figure 1; table 1 ---	2,4,5, 7-14,17
X	EP 0 352 751 A (FUJI PHOTO FILM CO LTD) 31 January 1990 (1990-01-31) page 5, line 56 - line 57; figure 1 ---	1,3
X	US 4 762 392 A (YAMAMOTO TAKASHI ET AL) 9 August 1988 (1988-08-09) table 1 ---	1,3
Y	US 5 933 437 A (DELAVAUX JEAN-MARC PIERRE) 3 August 1999 (1999-08-03) column 2, line 1 - line 40 ---	2,4,5, 7-10,12, 13
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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PCT/US 00/32934

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 519 801 A (LE NOANE GEORGES ET AL) 21 May 1996 (1996-05-21) abstract ---	11
Y	US 5 771 251 A (ARCHAMBAULT JEAN LUC ET AL) 23 June 1998 (1998-06-23)	14
A	column 1, line 45 - line 55 column 2, line 29 - line 34 figure 1 ---	7-10, 12, 13
Y	EP 0 320 990 A (POLAROID CORP) 21 June 1989 (1989-06-21) abstract ---	17
A	PAN J J ET AL: "166-MW SINGLE-FREQUENCY OUTPUT POWER INTERACTIVE FIBER LASERS WITH LOW NOISE" IEEE PHOTONICS TECHNOLOGY LETTERS, IEEE INC. NEW YORK, US, vol. 11, no. 1, January 1999 (1999-01), pages 36-38, XP000801382 ISSN: 1041-1135 figure 1 ---	5, 7-10, 12-16
A	HAMZA A A ET AL: "MEASUREMENT OF REFRACTIVE INDICES OF HOMOGENEOUS FIBERS WITH REGULAR OR IRREGULAR TRANSVERSE SECTIONS" JOURNAL OF APPLIED PHYSICS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 68, no. 6, 15 September 1990 (1990-09-15), pages 2639-2642, XP000161574 ISSN: 0021-8979 page 2640, column 2, line 1 - line 3; figure 8 ---	19
A	US 5 817 944 A (CHUNG DEBORAH D L) 6 October 1998 (1998-10-06) column 7, line 9 - line 12 -----	19

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International Application No

PCT/US 00/32934

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP 0884614 A	16-12-1998	JP 11064665 A US 6078715 A		05-03-1999 20-06-2000
EP 0352751 A	31-01-1990	JP 2035423 A JP 2119199 C JP 8020657 B JP 2035424 A JP 2119200 C JP 8020658 B DE 68926074 D DE 68926074 T US 5416877 A		06-02-1990 06-12-1996 04-03-1996 06-02-1990 06-12-1996 04-03-1996 02-05-1996 14-08-1996 16-05-1995
US 4762392 A	09-08-1988	JP 60254005 A JP 61022313 A DE 3587521 A DE 3587521 D DE 3587521 T EP 0183853 A WO 8505699 A KR 9205032 B		14-12-1985 30-01-1986 16-09-1993 16-09-1993 31-03-1994 11-06-1986 19-12-1985 25-06-1992
US 5933437 A	03-08-1999	EP 0867986 A JP 10284777 A US 5933438 A US 5936980 A		30-09-1998 23-10-1998 03-08-1999 10-08-1999
US 5519801 A	21-05-1996	FR 2701571 A EP 0611973 A		19-08-1994 24-08-1994
US 5771251 A	23-06-1998	CA 2189568 A DE 69515475 D DE 69515475 T EP 0759216 A WO 9531020 A		16-11-1995 13-04-2000 23-11-2000 26-02-1997 16-11-1995
EP 0320990 A	21-06-1989	US 4815079 A CA 1324517 A DE 3874701 A DE 3874701 T DE 320990 T JP 1260405 A JP 2781399 B		21-03-1989 23-11-1993 22-10-1992 11-02-1993 26-10-1989 17-10-1989 30-07-1998
US 5817944 A	06-10-1998	DE 19804747 A		24-09-1998